DATA PROCESSING DIGEST

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General Information

"Mechanized data processing for production control,"
by James M. Kalbach, Jr., E. I. duPont de Nemours & Co.

PROCEEDINGS, Time Study and Methods Conference, Society for Advancement of Management, New York, 1955; pages 107-114.

Data processing begins with sales orders

Mechanized data processing is defined as a "concept...for the unification and simplification of processing business data by electro-mechanical and/or electronic means. Three of the fundamental principles of such an approach are:

1 - Record all data at the originating point by mechanical means and create a punched paper tape or punched card as an automatic by-product of the original recording operation.

2 - Process this data and subsequent data we may add at a later time by mechanical means.

3 - Integrate all data in such a way that it serves all needs of Production, Sales and Accounting."

The starting point for the production control operation described is the order, from which data is duplicated by means of punched paper tape for the various functions emanating or resulting from the order.

"For Production Control to operate a plant effectively four basic questions concerning a given product must be answered." The four questions are:

Inventory Control: 1) How much shall be produced? 2) When shall it be produced or how often?

Machine loading: 3) Where shall it be produced or on what specific machines? 4) How shall it be produced--in what sequence considering other items competing for machine time?

Mechanized data origination, transmission, and processing provides the means of obtaining the data necessary for inventory control. This data along with information on 1) rate of sales, 2) protective stock required, and 3) the economical manufacturing quantity, can become the inputs for a mechanized procedure to tell us when an item should be considered for new production.

Judgment enters the picture here, in adjusting the called-for production to the present machine loads. Also, examination of sales trends may indicate action which the mechanical system, using only current figures, could not anticipate. However, "judgment will at least be based on up-to-date data produced by mechanized means and will allow us to evaluate any risk that we care to take."

Mechanization of machine loading may or may not be justified, "based upon the complexity of the process, the relationship between the production rate and the plant capacity, the variation in the production line, the flexibility of the use of the machines and the actual number of machines available."

"The more complex our operation the greater becomes the need for mechanized procedures."

"Three notes of warning pertaining to the installation of such a system should be emphasized.

"First, there is no ready-made system of data processing nor of production control....each installation must be tailor-made to the specific application in order to achieve the best results.

"Second, no system so far conceived has resulted in true automation in the sense that input of data to the system will result in infallible action or indication of action coming from the other end....

"Third, the installation of such a system is expensive. It takes a long time and requires specialized knowledge but the benefits to be gained are large.

"This approach to Production and Inventory Control is based upon complete integration of all information relating to orders. This system recognizes no divisional lines of authority between sales, production, and accounting, and produces a single set of figures for use by all. It requires a standardized procedure that embodies the routinization of all exceptions and is aimed at maximum return on investment. The only way to achieve this maximum return is by pushing the profit motivation down into the lower echelons of the company organization where decisions affecting profit are made."

"The impact of automation on the company organization," *by C. E. Knight and C. H. Fawkner, Plastics Division, Monsanto Chemical Company, Springfield, Mass.*

Strengthening Management for the New Technology, AMA General Management Series #178; pages 11-21.

Automation brings new management concepts

The paper suggests some management problems posed by increased automation.

The factory is envisioned by the authors, as it becomes more nearly automatic, to 1) become smaller and more compact with a minimum of in-process inventory, 2) have more nearly continuous operations, 3) have more highly specialized personnel, 4) record performances automatically and feed them to a central record activity, 5) make continuous automatic samplings, analysis, and correction.

Some specific considerations of management are: a steady program of consumer education toward acceptance of forms suitable for translation to automatic production; longer training of personnel because of higher technical skills required; lead time for construction and design which will increase to perhaps five or ten years (at present from 1½ to three years.)

"Operation of the automatic industrial system suggests further exploitation of electronic and servomechanisms to assist in decision making and execution, transmitting upward only those correlated facts for necessary human decision or for further computer processing at a higher strategy level...."

Increase in use of automatic manufacturing results in more specialists, particularly in the categories of 1) creative thinking, 2) information digesting, 3) programming. Management will find the use of these specialists will tend to change the traditional concept of company structure by shifting staff and on-line responsibilities into new patterns.

In the matter of centralization versus decentralization of management, present developments justify either philosophy. Decentralization at the product-family level seems to be developing in a number of recent industrial re-organizations. In this kind of management, "top company management, aided by modern techniques of information processing, would exercise surveillance only, unless for some reason operations of a product family 'went out of control.'"

"Computer applications to management problems," *by Jay W. Forrester, Massachusetts Institute of Technology.*

Strengthening Management for the New Technology, AMA General Management Series #178; pages 22-31.

Computers will aid management functions

"Perhaps, to the business executive, the most spectacular change [in electronic computer technical development] of the past 10 or 15 years is the continuous reduction in the unit cost of computation."

A graph illustrating the text reveals a comparative cost per million operations of about $80,000 by manual computation to $10 by electronic computer, and an accompanying increase in speed of .01 to 800,000 operations per second.

Future development trends:

1 - Equipment is being designed for more specific commercial uses.

2 - Improved storage devices are being developed for large-volume business records.

3 - Lessons learned in data storage for military uses will be applied to business techniques.

4 - The transistor will reduce power and air-conditioning requirements, and reduce floor space.

5 - New high-speed printers are being developed.

6 - Centralization of accounting operations will be speeded up and reduced in cost by new developments in telephone transmission.

"The high-speed electronic computer is apt to stimulate routine computing at the expense of too little thinking. Simply to mechanize, with electronic equipment, the processes now being carried out by other methods may not be the most effective way to use the new equipment....Many persons become engrossed with cost reduction as a sufficient end result in itself rather than as a way to make more data processing economically feasible."

Business applications divide into three categories: simple cost reduction wherein present methods are satisfactory but expensive; the indirect assistance to company management where improved data processing will make present types of information available to management at an earlier date; and the direct use of computing machines as an aid in making management decisions.

In the latter category the author suggests two areas of research as being fruitful to the businessman. One is the field of operations research, the other is the application of principles developed for automatic control mechanisms to the problems encountered by industrial management. "This general concept of using the principles of automatic control systems has been extended to the entire economic process in a provocative book entitled *The Mechanism of Economic Systems* by Arnold Tustin, published by Harvard University Press."

"How common language units stimulate the flow of data,"
by Glenn E. Hagen, Systematics, Inc., Hermosa Beach, Calif.

AUTOMATIC CONTROL, August 1955; pages 18-21.

Defining areas to automate

Data processing is viewed as a problem of language in which a group of data processing devices "converse" with each other and meet, on their collective periphery, the world of people and things with which they must communicate.

The author suggests the term *prime input* be given to "that point where information is first translated from...people and things into some form of computer talk." *Prime output* is "that point where results are translated back into a form directly usable by people and things."

A further concept is given--that of a *Domain of Automation.* This is defined as any computer or group of communicating computers which receives "all its incoming information via prime inputs" and delivers "all its results via prime outputs."

"To propose a domain of automation too large, too small, or one with improper boundaries is perhaps the most common mistake being made in the field today. Attempts to develop too small an electronic computer have been economically impractical because they become all input-output....As we go into large domains, we shorten our boundaries, cut down on the proportion of input-output, and take increasing advantage of the speed and simplicity with which machine components intercommunicate. In theory, therefore, one should immediately plan to make his entire business enterprise one vast domain, contact with people occurring only at its periphery.

"In practice, however, most business systems are so complex and involve so many detailed processes that it is folly to attempt a complete changeover based on the automatic equipment available on today's market."

Four methods of choosing boundaries of a proposed domain are mentioned: physical or geographical boundaries, department or functional boundaries, boundaries which represent the range of a certain piece of automatic equipment, and boundaries which arise naturally from the systematic elimination of redundancies.

"The first two are usually a mistake, the third is good but dangerous, the fourth is slow, but almost foolproof."

The four common types of redundancies discussed are: duplicate input, parallel input, repeated input, tandem input.

"Preparing for improved data processing methods and equipment," *Panel Discussion by J. Douglas Elliot, James Gibbons, James Thomson, Ralph W. Fairbanks, James M. Kalbach, Jr., and Sterling K. Atkinson.*

N.A.C.A. BULLETIN 1955 Conference Proceedings--2, Section 3, August 1955; pages 1758-1776.

Some ideas on planning for a data processing system

Some points brought out in the panel discussion are:

The mechanization of data should begin at the point of origin and be processed mechanically up to the point of processing electronically on the more advanced equipment.

Planning for integrated data processing should be achieved by looking at all of the departments and all of the incoming source material and so planning without being limited by department walls.

The benefit which comes of such planning is the better information that can be obtained more rapidly for management. This will result in a breakdown in the traditional barrier between production, sales, and accounting.

If the areas which can be affected specifically by integrated data processing hold more manual hours than it would cost for the machines to be installed, then the overall cost picture could bear the conversion and installation of whatever equipment might be contemplated.

One of the advantages to be gained from a study looking toward the use of electronic equipment is consolidation and simplification of activities.

The use of service bureaus may be practical for some companies. It was suggested that such use would help a company get experience for setting up its own computing center at a later time.

Decentralization of management need not preclude the use of a centralized computing service.

"B.C. versus A.C.," *by F. F. Bradshaw, President of Society for Advancement of Management.*

ADVANCED MANAGEMENT, August 1955, page 4.

O.R. provides the basis for scientific management

In an editorial, Mr. Bradshaw presents a challenge to management to rethink its role in industry. "Few management people yet appreciate the radical advance represented by the word *Automation.*"

"The computer contributes self-correction and 'feedback' to the machine, it also contributes self-correction and 'feedback' to management thinking. Management judgment and guidance will become increasingly scientific as operations research provides quantitative data for management decision."

"The need for integration of accounting systems and the design of electronic data-processing systems," *by Paul Kircher, University of California, Los Angeles.*

PROCEEDINGS, Western Joint Computer Conference (I.R.E.), 1955; pages 26-28.

System design must serve management

"Good systems design integrates not only within a function but between functions....The whole operation is, or should be, guided and directed by top management....The system design must meet their requirements, or there will still be friction [between the accounting system and the people who use it]."

"Translation of Russian technical literature by machine," *by J. W. Perry, Western Reserve University, Cleveland.*

MECHANICAL TRANSLATION, July 1955; pages 15-24.

Automatic translation theories tested

An experiment is described in which machine translation of Russian technical reports was simulated. Results showed that persons not knowing Russian could understand the subject matter of reports translated mechanically.

"Industrial Accountant's Handbook," *edited by Wyman P. Fiske and John A. Beckett*

Book, Prentice-Hall, New York 1954 (Second Printing 1955)

Accounting methods described

This complete, detailed handbook of procedures, methods, and philosophy of industrial accounting should be of some interest to those who are designing data-processing systems. There is no discussion of operations research methods, nor of the possibilities of common-language techniques or computers. The handbook does, however, give the details of standard industrial accounting (which includes most of the areas of accounting affected by automatic data processing) in an organized and complete, if conventional, manner. Attention is paid throughout to the necessity of providing management with the proper information.

The chapters on "Basic Concepts in Accounting," on "The Design and Administration of Business Systems," on "Machines for Accounting," on "Internal Check and Audit," and on "Cost Reports and Analysis of Results" will provide a good picture of the accountant's requirements for data processing for engineers and others who are encountering the accountant's viewpoint for the first time.

Equipment

"Pace of office automation continues to increase in first half of '55; Burroughs, Underwood show new units"

OFFICE MANAGEMENT, July 1955; pages 25, 33, 41

Sorting and reading devices

The Underwood Rapid-Sort is a high speed electronic media sorter which can sort forms of various weights and sizes when operated from a standard typewriter keyboard. Sizes of documents the machine will accept are in the range of 5½ to 8½ inches wide, and 2¾ to 4¼ inches wide. It will feed weights of paper stock from 15 to 90 pounds.

The Rapid-Sort can segregate media such as sales checks, tax bills, job tickets, and bank checks. The operator identifies alphabetical or numerical classification by looking at the top copy. As she depresses the appropriate keys the media are shunted to the correct bins.

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Burroughs' check reader designed for the National City Bank of New York* reads travelers checks at the rate of 7200 an hour. The device consists of a cable-connected reader and punch, each unit of which is approximately the size of an office desk. "The machine scans the printed numbers on every check (which identify its denomination and serial number) by means of electronics and a photo-electric device, and automatically punches a card to correspond."

Burroughs has also developed a method of automatic check processing through reading an invisible code preprinted on checks. The code identifies the depositor and the bank on which the check is drawn. "It is anticipated also that it will be possible to code the amount on the checks as an automatic by-product of proving operations in the bank. With this technique, amounts will be read automatically, permitting an even higher degree of automation."

* See DPD August 1955, page 11--BUSINESS WEEK; and this issue, page14.

"Automatic translation of printed code to impulses acceptable to computing equipment," *by J. T. Davidson and R. L. Fortune, Standard Register Co., Dayton, Ohio.*

PROCEEDINGS, Western Joint Computer Conference, (I.R.E.), 1955; pages 29-33.

Pre-printed coded forms

The Stanomatic system described senses information printed in a special ink on business forms at the speed of 500 forms per minute. Typed or written information may also be on the form. The coded information is translated and fed either to high speed data handling equipment or through memory circuits to conventional machines (tab card punches, magnetic tape, teletype, etc.). Thirty characters may be recorded (more under special conditions). The output may be any computer number system; 5 to 9 channel paper-tape, or other machine code.

Documents are prepared by 1) being preprinted with appropriate codes at the facilities of Standard Register, 2) being encoded by special keyboard devices (automatic or manual), or 3) by attachments to bookkeeping machines and typewriters. Codes may also be inserted by embossed credit cards. Both continuous and individual forms may be encoded. The coded area may occur anywhere on the form.

"News notes of the industry--IBM 702-705"

JOURNAL OF MACHINE ACCOUNTING, July-August, 1955; pages 19, 20.

Technical data on high speed printers

Technical data on the IBM 702 and 705 data processing machines includes the following information about 719 and 730 High Speed Printers:

	719	730
Printing speed	1000 lines a minute for each model	
Printing positions per line	120	60
Maximum printing speed	120,000 char/min	60,000 char/min
Alphabetic and numeric characters, all positions	47 plus 11 special characters	
Horizontal spacing	10 characters to the inch	
Vertical spacing	6 lines/in. single space, or 3 lines/in. double space without loss of printing time	
Forms feed	Continuous forms up to 16¾" wide by 22" long--original and 7 legible carbon copies Paper controlled by two forms tractors, one above and one below the printing lines	
Information source	a. Direct input from 702 or 705 b. Independent tape-to-printer with 727 Magnetic Tape Unit	
Coupling Unit	760 Control and Storage Unit used between either printer and 702 or 705, or between printer and tape unit. 760 contains power supply and control circuitry for printers, and makes conversion for printing. May also be used as additional storage unit for 702 or 705.	

"Data collection as a by-product of normal business machine operation,"
by J. C. Taylor, The National Cash Register Company, Dayton, Ohio.

PROCEEDINGS, Western Joint Computer Conference (I.R.E.), 1955; pages 34-41.

Point of sale readers

Two devices are described for the automatic collection of data at the point of sale. The first unit is a modified standard cash register with all of the usual features. When the data is punched into the register in the normal fashion it is stored in switches, and is then punched onto paper tape for later entry into computers or other data-processing equipment. The unit can be programmed by means of wiring in a program board, so that the data may be entered from the register keys to the paper tape in four different sequences depending upon which transaction key was used. The transaction code register number and an end-of-frame mark are also inserted.

A second unit can be added to the above system which allows the reading of pre-punched garment or price tags. This allows the clerk to enter data for a sale much more rapidly; most of the data such as style, manufacturing and other numbers, department, and prices all being entered automatically. An interlock insures that a tag has been inserted for each item to be recorded in the sale.

The output may be 5 to 8 channel tape. A 400-foot roll will hold 48,000 characters or about 1500 transactions.

"Maid service for computer circuits"

AUTOMATIC CONTROL, August 1955; page 23.

Automatic trouble-shooting device

Monroe Calculator's Monrobot Division has designed the MAID (Monrobot Automatic Internal Diagnosis) which performs trouble shooting of internal faults in a routine that requires no special skill on the part of the maintenance man. When an error is detected, MAID makes an attempt to find the fault, automatically halting the computer on the same program step. This search process is repeated as long as the fault remains. Computation continues if the fault is intermittent but halts at the occurrence of the next error. MAID actually takes only thirty seconds to narrow the trouble location and the persistent fault to one point in the system. It can find a number of simultaneous faults in different circuits. When one fault is corrected, the device goes looking for another.

"Computer controls parts inventory"

ELECTRONICS, August 1955; page 20.

Otis Elevator will soon have a specially designed machine to handle a 35,000-item inventory.

Applications

Facts and figures of systems in operation

"Application of data processors in production," *by C. R. DeCarlo, IBM, New York*

PROCEEDINGS, Western Joint Computer Conference (I.R.E.), 1955; pages 61-65.

As the capabilities of large computers become known it is natural that "attempts should be made to utilize them in solving problems in production and accounting." Some problems arise, however. "The availability and validity of data necessary to a machine operation are not always guaranteed. Often departmental responsibilities must, or should, be consolidated in order to extract maximum efficiency from the data processor."

Several interesting applications of large-scale data processors have been made to production problems. One is from an aircraft firm. A problem here is, starting with the basic contracts, to create a master schedule. Such a schedule for all models might require 4000 pages and previously would have taken one to four weeks to process. Such schedules are created on an IBM 701 within 24 hours at a 40% reduction in cost. Because of the high speed it is possible to evaluate several schedules.

From the master schedules ultimately shop orders have to be created. This involves engineering and manufacturing parts lists, the parts inventory file, spare requirements file, parts inventory file, and contract and work order cost file. A main schedule file is processed against these.

Changes in parts requirements, engineering, manufacturing practice, losses, unplanned receipts and issues, etc., are processed against the main file weekly. At the same time the requirements per schedule are examined to determine what shop orders are required. Finally, the orders are written, and a parts activity ledger and an open order card (for subsequent use) are created.

"Perhaps the most important concept illustrated by the use of the Type 701 EDPM lies in the consolidation of many files, all basically related to the part number, into one file, and the weekly processing of this file against one change file representative of all types of change, to create a variety of output data and automatically revise the main file to current status. Thus engineering, manufacturing, inventory, and planning information are all treated simultaneously, making for better management."

This problem involves almost 100,000 parts and 45,000 weekly changes. The main file consists of 27 reels (47,000,000 digits); the changes data, 5 tapes. At least eight output tapes will be prepared. The total processing time is under 40 hours.

Another application was developed by IBM itself. The application is basically an analysis of inventory and usage data to determine dates when new stock is due. These dates are then combined with economic order quantity calculations to determine lot size. By adding routine data it is possible to create schedules for the fabrication of the parts. In the process, load totals for each operation, raw material requirements, and load hours are accumulated.

This operation involved 30,000 parts in a 280-day schedule. Previous calculations (which were not as inclusive) required 3200 hours on a CPC and 3,000,000 cards. Using a 701, six hundred hours of conventional punched card equipment and 1,000,000 cards plus 41 hours on the 701 were required.

The output reports are used to determine adequacy of facilities, manpower requirements, and the need for sub-contracting. Raw material ordering is also aided.

Detailed machine scheduling has also been tried experimentally. The facilities consisted of 40 machine groups for 700 parts. The objective was to make the loads on the machine fairly uniform. The result was cards showing the sequence for each machine group; also similar documents describing requirements for operating managers, and data telling stock analysts when to initiate orders. Machine loading data was also available.

"Production men--produce your paperwork automatically," *by P. B. Garrott, Standard Register Company, Dayton, Ohio*

AUTOMATION, September 1955; pages 75-82.

Simple techniques in integrated data processing

Some examples are given of ways in which integrated data processing may be applied to specific production jobs.

In the first example, a manufacturing order is received via teletype from a sales order which originated at the distant sales office (see DPD June 1955, page 5--Alcoa application). "It includes all the basic information which was available from the sales office, including the general items which describe who wanted what shipped where." If additional information is needed before manufacturing operations begin, this additional information is typed in the provided space on the form. The additional manufacturing information is very likely to be a standard operating procedure which would be maintained in two forms--first, in the form of a typed document which people may read, and second, in the form of a strip of punched paper tape. The punched tape would be inserted in the tape-operated typewriter or wire-sending machine to produce the required information for the manufacturing work order. This operation may be part of the writing of the production order itself, or may be handled as a secondary and subsequent operation. The primary benefit of this simple procedure is the accuracy with which the manufacturing information is placed on the order.

Another example given is the preparation of parts tags. In preparing material for shipment or storage, it is often necessary that a number of tags or labels be prepared. In the example, 24 cartons of a product are to be shipped. Four sets of 6-part labels are to be prepared. The first set is prepared manually on a tape-punching typewriter. The resulting tape is then used to type the three remaining sets of 6-part labels, producing the necessary total of 24 labels for the 24 cartons. However, the same tape need not be inserted into the reader three times. If the original tape is inserted into the reader as the typing occurs, the tape will automatically feed itself into the reader and

repunch itself while it is typing the second, third, and fourth set. If the basic shipping information could be secured from an earlier step in the transaction in the form of a punched tape, this tape could then be used for label preparation, eliminating the first manual typing of labels.

The next example has to do with the sales order which contains a number of different items, which must be separated in the manufacturing process, and reassembled for shipping purposes. The example assumes the order is being received in the plant by wire transmission. It is suggested that the order be received not only on a multiple form but also on a paper tape, and that a special signal code be inserted before each of the items on the order. To break down the coded tape, item by item, either the wire communications equipment or a tape-reading, tape-writing typewriter could be used. In preparing a production order form, the tape would automatically type in the heading information, then, because of the special code, stop. The operator would then advance the tape to the first item on the tape and complete the order. On the second form, the tape would automatically type the heading, then stop. The operator would advance the tape past the first item to the second item, and when the information was filled in, the special code would again stop the typewriter. The procedure would be repeated until each item had been filled in on its own production order form. Both speed and accuracy result from this use of punched tape.

In the example of the preparation of a bill of material, two tape-reading, tape-punching typewriters are connected by cable so that both could be operated from the keyboard or tape-reading unit of one of the machines. Master tapes containing the bill of material for each product involved would have been prepared. Now, the bill of material master tape is inserted in the reading unit of the "master" machine, and bill of material forms are inserted in the master machine and material requisition forms in the "slave" machine. Two separate but related jobs can now be processed simultaneously. When properly planned, with forms designed for this operation, the slave machine can prepare a material requisition for each item being typed on the bill of material on the master machine.

This tandem operation can be used also, in preparing shipping orders on a branch of wire communications circuit from the sales office. The shipping papers might include bills of lading, packing slips, labels, etc. This could be in addition to the set of forms being typed on the receiver in the production department.

In the first example, a manufacturing order is received via teletype from a sales order which originated at the distant sales office (see DPD June 1955, page 55--Alcoa application). Another example is the preparation of parts tags or labels from punched paper tape.

In the third example, a sales order contains a number of different items which must be separated in the manufacturing process, and reassembled for shipping purposes. In the last example, the preparation of a bill of material, material requisitions are processed simultaneously.

This is an easily-read understandable article, the third in a series (see DPD April 1955, pages 4 and 5).

"Automation for department stores"

DEPARTMENT STORE ECONOMIST, August 1955; pages 38, 39.

Buyers have sales report data next morning

Jordan Marsh, Boston department store, has mechanized unit merchandise control in 38 ready-to-wear departments in its main and branch stores. The system was developed by Remington Rand, Inc., and A. Kimball Company, manufacturer of tag marking machines. As each garment is sold, the sales clerk detaches its perforated tag stub, and at the end of the day these stubs are collected from sales points in the main and branch stores. The tags are fed into the specially designed Remington Rand tag-controlled card reproducer, which automatically transfers the information into 90-column punched cards at the rate of 100 a minute. The cards are then run through a high-speed sorter, which automatically arranges them according to department, classification, price, size, color, and other pertinent categories. The tabulator then automatically accumulates and prints from the cards the desired information into a detailed sales report. This report is in the buyers' hands at the main and branch stores by 9 o'clock the following morning.

"Common language--electronic reader converts raw data to common language"

AUTOMATIC CONTROL, August 1955; pages 28, 29.

Facts about travelers' check reader

The electronic device designed by Burroughs to read travelers checks at the First National City Bank of New York, has reduced the error factor of one percent in key punching to less than one-tenth of one percent, while doing the work more than eight times faster than previous methods. An experienced card-punch operator can read serial numbers on the travelers checks and transfer the information onto punched cards at the rate of 700 an hour. In peak periods 23 people must be employed full time to process 130,000 checks per day. The new device reads the checks at the rate of 7200 per hour, and punches the cards automatically.

(See DPD, this issue, page 8.)

Integrated data processing

PAPERWORK SIMPLIFICATION, Second Quarter 1955.

Four examples of simplifying paperwork

Latrobe Steel Co. uses six Programatic Flexowriters, three in the Order-Billing Department and the other three connected by cable 300 feet away in the Mill Warehouse, to prepare all order and shipping papers in one typing operation.

Rockwell Manufacturing Co. prepares orders by selecting prepunched IBM cards which fit the conditions of the order, keypunching other cards with specific information necessary, mark-sensing quantities (which are automatically punched), then preparing from the deck of cards a programmed paper tape which is used to teletype the order to the warehouse.

Kennametal, Inc. installed internal teletypewriters to link the Order Department to Production Control and Stock Room Shipping Department. Each department instantly receives the information it needs on unified forms in set make-ups suited to the department function.

The Aluminum Cooking Utensil Co. processes orders in a manner similar to that of Rockwell. However, instead of preparing a paper tape from the card deck, a typist prepares a proof copy of the order, simultaneously preparing a transmittal tape for the teletype.

Control

"Automatic machining--a view and a preview," *by Waldo H. Kliever, Clevite-Brush Development Co.*

CONTROL ENGINEERING, Sept. 1955; pages 112-122.

Closed-loop techniques and new methods of feeding instructions have made possible remarkably flexible machining tools. This article, the first of two, covers ways to instruct and ways to drive these new automatic machine tools.

"Space dynamics in machine tool controls," *by John L. Bower, North American Aviation, Inc.*

CONTROL ENGINEERING, September 1955; pages 105, 106.

This short article is an excellent engineering discussion of the major parameters to consider in designing automatic controls for machine tools--a "must" article for anyone seriously studying this field.

"Automation in the United Kingdom"

JOURNAL, Institution of Production Engineers, June 1955; pages 331-333.

Automation is widespread in Great Britain

"Automation has been adopted in the United Kingdom on a wider scale than is generally believed to be the case. Outstanding examples are the great oil refiners...steel sheet rolling and tin-plate mills...the chemical industry... glass industry and textile manufacture...motor vehicles where automation is firmly established....by far the greater part of automatic machinery used by other industries is made in the engineering industries which are still using, in the main, what can be called traditional methods."

Systems Design

"An optimization concept for business data-processing equipment,"
by D. R. Swanson, Ramo-Wooldridge Corp., Los Angeles.

PROCEEDINGS, Western Joint Computer Conference (I.R.E.), 1955; pages 43-48.

Ratio of computers to tape units is mathematically derived

By making some restrictive, but not unrealistic, assumptions as to the cost of equipment and as to processing time, a relationship is derived between the number of processors (computers) and the number of associated tape units required in a data-processing system. The analysis indicates that it may often be more economical to use several processors and a smaller total number of tape units. At least "...it is generally true for magnetic tape memories that cost increases with decreasing access time; in that circumstance" according to the analysis "an optimum balance between tapes and processors must exist." This applies to typical accounting system processing problems.

The case where rapid (therefore "random") access to data in a file is required is also considered. The method developed indicates the number of tape units required to make the data available in the specified time. Here the analysis indicates that "the requirements of many...so-called random access problems in business can actually be met with magnetic tape equipment."

((The approach in this article is mathematical, but is suggested for those who like sophisticated systems design methods.))

"Data-processor requirements in production and inventory control,"
by H. T. Larson and A. Vazsonyi, Ramo-Wooldridge Corp., Los Angeles

PROCEEDINGS, Western Joint Computer Conference (I.R.E.), 1955; pages 48-60.

Production schedules set by mathematics

This article aims at a mathematical approach to the problem of developing schedules (or requirements) for the construction of parts and sub-assemblies, given the shipping schedule for complete assemblies (and spare units). The approach is to express shipping schedules, bills of material factors (gozinto charts), setbacks (lead times), and other factors in a formalized mathematical notation known as a matrix. The rules for manipulating matrices are clearly defined, and a computer may be programmed to perform these operations. The result is that requirements for parts at each date can be determined whenever the shipping schedule or other factors change. Machine loading and labor requirements can be developed, also.

This approach to the production scheduling problem requires considerable computing effort. The last part of the article indicates the size of computer memory and computing speeds that might be required in typical cases. Some suggested computing procedures are given which reduce the memory space requirements. The processor characteristics which seem to be required are indicated.

((The article is suggested for those interested in formal approaches to production scheduling problems.))

Training, Seminars, Meetings

"Computers in Business and Industrial Systems," Eastern Joint Computer Conference (IRE-AIEE-ACM), Nov. 7-9, 1955; Hotel Statler, Boston, Mass.

Controllers Institute, Nov. 7-9, 1955; Statler Hotel, Los Angeles.

National Machine Accountants Association Electronic Business Systems Conference, Nov. 10, 11, 1955; Statler Hotel, Los Angeles. Registration fee (member and nonmember) $15.00. For further information write: Electronic Business Systems Conference, P. O. Box 221, South Gate, Calif.

Second Computer Clinic (along with the Second International Automation Exposition) Nov. 14-17, 1955; Chicago Navy Pier. Registration fee: $5.00. Six two-hour lecture and demonstration sessions on a choice of types of computers. For further information and registration write: Second International Automation Exposition, 845 Ridge Avenue, Pittsburgh 12, Pa.

"Problems of electronic applications in the office," AMA Seminar; two meetings--Nov. 28-30, 1955; Jan. 9-11, 1956. American Management Association, New York.

Engineering and Management Course, University of California at Los Angeles; Jan. 23 through Feb. 2, 1956. Includes five classes in data processing and related subjects among others. For further information write: Edward P. Coleman, Coordinator, Engineering and Management Course, College of Engineering, University of California, Los Angeles 24, Calif.

Western Computer Conference (IRE-AIEE-ACM), Feb. 8-10, 1956; San Francisco.

Business Data Processing—A Review

Part III - The Tools Available

In Part II of this series (DPD July, August, 1955) we covered the basic function of a business data processing system and the pattern of processing which normally occurs. To review, the functions are data recording, data gathering, filing (or storing) with the associated process of file-maintenance, computation (for report preparation) and presentation. Table I reviews the types of equipment available to perform these operations.

Usually systems are mixed; input is almost always manual. Recording of data might be manual and transmitted to the data processing center by a mail system. At this point it may be keypunched into tab cards so that filing, file maintenance, computing and printing are on electro-mechanical (tabulating) equipment. Or it might be transmitted electrically (see DPD, "Production men--etc.," page 12, this issue). Auxiliary devices are available to convert data from one of these media to another. Table II lists some types of conversion devices. Actually, equipment can be built for the conversion of data from any code and medium to any other code and medium. In general the number of conversions should be kept to a minimum to reduce delays and errors.

Type of System	Data Recording	Data Gathering	Filing	File Reference	File Maintenance	Calculating	Presentation
Manual	written records on paper	mail systems	tub files using ledger cards, documents	manual	human posting	human	written records, journals, reports
Machine-aided manual	typewriter on paper	pneumatic tubes, methods of transmitting hand-written messages	tub files using ledger cards	devices for automatically selecting cards from tub files	adding machines, bookkeeping machines (mechanical and electronic)		typewriters, bookkeeping machines
Electro-mechanical	prepunched cards, "mark-sensing" and other pre-coding devices on paper or cards, typewriters for punching cards and paper tape.	Teletype and telephone lines for punched paper tape or cards	tab card files	collators for selecting and merging; sorters for arranging	"accounting machines (tabulators)"; card calculators (electro-mechanical and electronic)		"accounting machines (tabs)"
Automatic (Electronic-magnetic)	devices for reading printed documents, devices for gathering data directly	wire systems for electronic signals	* magnetic tapes, drums, cores	* electronic devices, computers or special devices(e.g. electronic sorters and file maintenance devices)		* computers	* high-speed printers; graph plotters

* These four items are often combined into one "computer system."

A Classification of Data Processing Equipment

Table I

One problem facing the designer of business systems is selecting the proper type of equipment for each function; and, of course, the most economical unit of that type available.

Part IV of this series will discuss the information about a business which is required in order to begin the design of improved data processing systems. Part V will review the use of this information in selecting equipment.

To → / From ↓	Written records	Punched paper tape	Tab cards	Magnetic tape
Written records	duplicating methods	automatic typewriters	keypunches, mark-sense readers, character-sensing readers (automatic)	special typewriters, automatic character sensing readers
Punched paper tape	automatic typewriters	---	paper-tape to card converters	paper-tape to card converters
Tab cards	punched card printers	tab cards to paper-tape converters	reproducers	tab card to magnetic-tape converters
Magnetic tape	high-speed printers	magnetic-tape to paper-tape converter	magnetic-tape to card converters	Probable use of computer

Classification of Conversion Devices

Table II

Correction: The address of the American Institute of Electrical Engineers as listed in the September issue on page 19 is incorrect. The address should read, 33 West 39th Street, New York 18, N. Y.

Resource

Following is a list of periodicals which are reviewed regularly by the publishers of DATA PROCESSING DIGEST for significant information in the data processing and related fields.

Advanced Management
Aeronautical Engineering Review
American Business
American Gas Association Monthly
Automatic Control
Automation
Aviation Age
Banking
Best's Insurance News
Business Week
Chain Store Age
Chemical Processing
Chemical Week
Computers and Automation
Consulting Engineer
Control Engineer
The Controller
Cost and Management
Credit Executive
Credit and Financial Management
Credit World
Department Store Economist
Dun's Review
Econometrica
Electronics
Electrical Engineering
Electronic Design
Factory Management & Maintenance
Fortune
Harvard Business Review
Iron Age
I. R. E. Proceedings
Industrial Quality Control
Instrument Manufacturing
Journal of Accountancy
Journal of American Institute of Planners
Journal of Association for Computing Machinery
Journal of Computing Systems
Journal of the Franklin Institute
Journal of Institution of Production Engineers
Journal of Industrial Engineering
Journal of Society for Industrial and Applied Mathematics
Journal of Machine Accounting
Journal of Operations Research Society
Management Science
Management Methods
Merchants Trade Journal
N.A.C.A. Bulletin
Nation's Business
The Office
Office Appliances
Office Management
Office Executive
Oil & Gas Journal
Paperwork Simplification
Production
Purchasing
Railway Age
SAE Journal
The Spectator
Steel
Stores
Systems and Procedures Quarterly
Systems Magazine
Tooling and Production
Western Electronic News

References

Advanced Management
74 Fifth Avenue
New York 11, New York

American Management Association
330 West 42nd Street
New York 36, New York

Automatic Control
430 Park Avenue
New York 22, New York

Automation
Penton Building
Cleveland 13, Ohio

Banking
12 East 36th Street
New York 16, New York

Control Engineering
330 West 42nd Street
New York 36, New York

Department Store Economist
100 East 42nd Street
New York 17, New York

Electrical Engineering
500 Fifth Avenue, Suites 7 & 8
New York 36, New York

Electronics
330 West 42nd Street
New York 36, New York

Institute of Radio Engineers
1 East 79th Street
New York, New York

Journal of Machine Accounting
214 North Madison Avenue
Chicago 1, Illinois

Management Science
Case Institute
Cleveland 6, Ohio

Mechanical Translation
Massachusetts Institute of Technology
Cambridge, Massachusetts

N.A.C.A. Bulletin
505 Park Avenue
New York 22, New York

Office Management
212 Fifth Avenue
New York 10, New York

Paperwork Simplification
The Standard Register Company
Dayton 1, Ohio

Prentice Hall, Inc.
70 Fifth Avenue
New York, New York

Society for Advancement of Management
(see Advanced Management)

Wall Street Journal
44 Broad Street
New York 4, New York

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